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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/558,367	11/29/2005	Munehiro Tada	Q91732	3745

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SUGHRUE MION, PLLC
2100 PENNSYLVANIA AVENUE, N.W.
SUITE 800
WASHINGTON, DC 20037

EXAMINER	
AU, BAC H	

ART UNIT	PAPER NUMBER
2822	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/558,367	TADA ET AL.	
	Examiner	Art Unit	
	Bac H. Au	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 December 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4,6-12,14-19 and 21-23* is/are pending in the application.

4a) Of the above claim(s) *21-23* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1-4,6,7,10-12 and 16-19* is/are rejected.

7)☐ Claim(s) *8,9,14 and 15* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's amendment dated December 11, 2008 in which claims 1, 3-4, 6-12, and 14-19 were amended, and claims 5, 13, and 20 were cancelled, has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-4, 6-7, 10-11, and 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Meynen (U.S. Pub. 2003/0001282) in view of Besser (U.S. Pub. 2001/0051420).

Regarding claims 1-4, 6-7, 10-11, and 16-18, Meynen [Figs.1-3] discloses a wiring structure wherein the wiring structure is so constituted that, in a wiring structure of multi-layered wiring in which a plurality of unit wiring structures are laminated [Paras.14-15], the unit wiring structure having at least one metal wiring and at least one metal connection plug formed by filling the metal into a wiring trench and a via hole [Fig.2] formed in an insulation film [2] on a substrate forming a semiconductor element,

at least one of the unit wiring structures includes an insulation barrier layer with organic substance [1] inserted between at least one of the metal wiring and the metal connection plug [5,9], and an interlayer insulation film [2],

at least a portion of a side surface of at least one of the metal wiring and the metal connection plug being overlaid by the insulation barrier layer;

wherein said insulation barrier layer further includes silicon atoms [Paras.11,22-33];

wherein said metal is copper, said metal wiring is a copper wiring, and said metal connection plug is a copper connection plug [Paras.14-15,37];

wherein the interlayer insulation film is formed on at least one of the copper connection plug [5], at least a portion of a side surface of at least one of a wiring trench and a via hole [6] formed through the first insulation film [3], the porous insulation film [2] and the second insulation film [4] being overlaid by the insulation barrier layer including the organic substance [1];

wherein the porous insulation film is made of a porous film having relative dielectric constant no greater than 3.0 [Para.3];

wherein the insulation barrier layer further includes silicon atoms [Paras.11,22-33];

wherein the insulation barrier layer including the organic substance is made of organic substance including Si-O binding [Paras.11,22-33];

wherein the insulation barrier layer including the organic substance is made of organic substance including Silicon in the range of 1 atm % to 10 atm % [Paras.11,22-33];

wherein the insulation barrier layer including the organic substance is made of carbon, silicon and organic substance [Paras.11,22-33];

wherein both of the first insulation film [3] and the second insulation film [4] are made of the same material [Paras.35-36];

wherein both of the first insulation film and the second insulation film are made of the same material, and made of either one of SiCN, SiC, SiCNH, SiCH and SiOCH [Paras.35-36].

Meynen [Figs.1-3, paras.14-15] discloses a multilayer metallization with various laminated insulation layers used as interlayer dielectric layers, etch stop layers, hard mask layers, and porous insulation layers. Meynen does not clearly disclose the specific layers as required by the claim. Besser [Figs.11-18] more clearly discloses a wiring structure wherein an interlayer insulation film in which a first insulation film [1110],

a third insulation film [1120], a fourth insulation film [1115], a porous insulation film [1130] and a second insulation film [1160] are laminated in series, is formed on the copper wiring [1125], a side surface of a wiring trench [1230] formed through at least the second insulation film and the porous insulation film, and a side surface of a via hole [1220] formed through the fourth insulation film, the third insulation film [1120] being overlaid by the insulation barrier layer [1420] including the organic substance, and carbon content of the organic substance being preferably larger than that of the first insulation film, the second insulation film and the fourth insulation film [Para.51].

Because both references teach methods of fabricating metal interconnects in semiconductor devices using a sealing insulation barrier layer, it would have been obvious to one skilled in the art to substitute one method for the other to achieve the predictable results of improving the metallization layer characteristics and device performance.

3. Claim 12 is rejected under 35 U.S.C. 103(a) as obvious over Meynen (U.S. Pub. 2003/0001282) in view of Besser (U.S. Pub. 2001/0051420), as applied to claim 1 above, and further in view of Yang (U.S. Pat. 7132363).

Regarding claim 12, Meynen [Paras.11,22-33] discloses various materials used for the insulation barrier layer, including materials with compositions of $Si_aO_bC_cH_d$. Hence, Meynen discloses wherein the insulation barrier layer including the organic substance is made of a Divinyl Siloxane Benzo Cyclobutene film.

Alternatively, Meynen fails to explicitly disclose wherein the insulation barrier layer including the organic substance is made of a Divinyl Siloxane Benzo Cyclobutene film. However, Yang [Col.4 lines 19-54] discloses Divinyl Siloxane Benzo Cyclobutene as a known and suitable alternative to numerous dielectric material used in forming metallization layers. Because both references teach methods of fabricating metal interconnects in semiconductor devices using a sealing insulation barrier layer, it would have been obvious to one skilled in the art to substitute one method for the other to achieve the predictable results of improving the metallization layer characteristics and device performance.

4. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Meynen (U.S. Pub. 2003/0001282) in view of Kim (U.S. Pub. 2002/0185671).

Regarding claim 19, Meynen [Figs.1-3] discloses a wiring structure wherein the wiring structure is so constituted that, in a wiring structure with a multi-layered wiring formed in an insulation film on a semiconductor substrate [Paras.12-15], which is provided with a metal wiring including Cu as a main component formed through a porous insulation film [2] and a second insulation film [4] laid on the porous insulation film, and a first insulation film [3] formed on the second insulation film, the first insulation film and the second insulation film are made of the same material [Paras.35-36].

Meyen discloses wherein the material constituting the first insulation film and the second insulation film is made of material including silicon carbide, silicon nitride, and silicon oxide as a main component. Meyen fails to explicitly disclose the material

including silicon carbonitride as a main component. However, Kim [Figs.1A-F] discloses wherein the material constituting the first insulation film [14,16] and the second insulation film [16,18] is made of material including silicon carbonitride as a main component [Para.38]. Kim discloses and makes obvious the suitable alternatives of silicon nitride, silicon carbide, and silicon carbonitride. Because both references teach methods of fabricating metal interconnects in semiconductor devices using interlayer dielectrics and multiple etch stop and mask layers, it would have been obvious to one skilled in the art to substitute one method for the other to achieve the predictable results of having the desired wiring design and layout of the metallization layers for the required device performance and functionality.

Allowable Subject Matter

5. Claims 8-9 and 14-15 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: Prior art does not fairly disclose or make obvious the claimed structure taken as a whole, specifically, the limitations of

wherein the insulation barrier layer including the organic substance includes silicon atoms in a range smaller than the carbon content of the first insulation film, the second insulation film and the fourth insulation film;

wherein the insulation barrier layer including the organic substance is made of a film of Divinyl Siloxane Benzo Cyclobutene, the first insulation film is made of a SiCN film, the second insulation film is made of a Si02 film, the porous insulation film is made of a porous SiOCH film, the third insulation film is made of a porous SiOCH film, and the fourth insulation film is made of a Si02 film; and

wherein the insulation barrier layer including the organic substance is made of a film of Divinyl Siloxane Benzo Cyclobutene, the first insulation film is made of a SiCN film, the second insulation film is made of a Si02 film, the porous insulation film is made of a porous SiOCH film, the third insulation film is made of a nonporous SiOCH film, and the fourth insulation film is made of a SiO2 film.

Response to Arguments

6. Applicant's arguments filed December 11, 2008 have been fully considered but they are not persuasive. Applicant asserts that Meynen and Besser teach away from one another and that combining Besser and Meynen would destroy the functionality of Meynen. This assertion is not persuasive. Applicant has not clearly explained how combining Besser and Meynen as suggested would destroy the functionality of Meynen, and is not understood how the references teach away from one another. Both references teach methods of using a conforming film to seal pores in the sidewalls of openings in the interlayer dielectric, facilitating the forming of the conductive wiring in the openings [Meynen, para.16; Besser, para.48]. As already discussed above in the treatment of claim 1, Besser was relied on to more clearly disclose the different

interlayer dielectric layers and the multiple etch stop and mask layers, as indicated by Meyen. The references are analogous and a rationale to combine was given. The combination of Besser and Meynen as suggested is deemed proper, and does not destroy the functionality of Besser.

Applicant's arguments with respect to claim 19 have been considered but are moot in view of the new ground(s) of rejection. Applicant asserts that "Meynen teaches that these layers may be selected from the same group of materials, there is no specific teaching in Meynen towards making the etch stop layer 3 and the sacrificial hard mask layer 4 out of the same material in any given embodiment". This assertion is not persuasive. By providing the same group of materials to be used for layers 3 and 4, Meynen does indeed disclose an embodiment where layers 3 and 4 are made out of the same material, as well as all the other embodiments where they are made out of any combination of the disclosed group of materials. In addition, Meynen discloses the selection of the material for layers 3 and 4 is based on the etch selectivity of the interlayer dielectric layers. If the etch selectivity of the interlayer dielectric layers are the same, it would be obvious to form layers 3 and 4 out of the same material to simplify the manufacturing process and insure an effective etching step.

Overall, Applicant's arguments were not persuasive. The claims stand rejected and the Action is made Final.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bac H. Au whose telephone number is 571-272-8795. The examiner can normally be reached on Mon-Fri 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/B. H. A./
Examiner, Art Unit 2822

/Kevin M. Picardat/
Primary Examiner, Art Unit 2822